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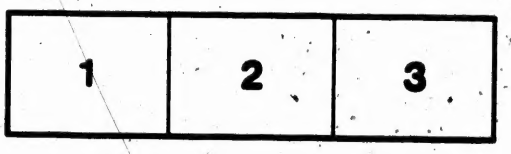

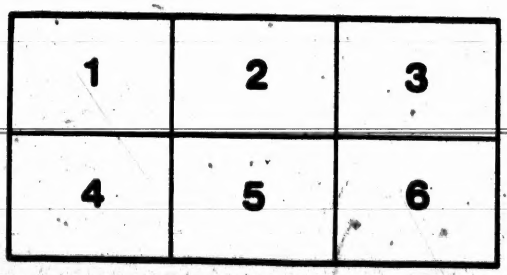

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Wire:

Its Manufacture, Antiquity, and Relation to Modern Uses.

WITH THE COMPLIMENTS OF
THE B. GREENING WIRE CO. Ltd
HAMILTON, CANADA.

WIRE

Its Manufacture, Antiquity and Relation to Modern Uses.

WIRE, in its various manufactured forms and composition, has during the present generation become so important a factor in some of the great inventions and engineering achievements, that a few facts as to its uses and manufacture may be interesting to many of our customers.

It is but within the present century that the Electric Telegraph, the Ocean Cables, the great Suspension Bridges, the useful and important Telephone, the Electric Railroads, the drilling for natural gas, the making of wire fencing, nails, etc., etc., has created such an immense demand for this article, and stimulated an industry

that now takes such high rank amongst manufactures.

The art of making wire has been traced back to the year 1700 B. C. Gold wire decorated the sacerdotal robe of Aaron. A specimen of wire, made by the Ninevites 800 years B. C., is exhibited at the Kensington Museum, London, England. Homer and Pliny referred to similar productions in their early writings. Metal heads, with imitation hair of wire, recovered from the ruins of Herculaneum, are in the Portici Museum, Naples. From such remote eras up to the fourteenth century, wire in its general acceptance was produced by hammering out strips of metal, and not by the process of "drawing," as now practiced.

In the middle ages this industry was extensively pursued, and the artificers thus engaged were termed Wire Smiths, but in the earliest days of the manufacture, gold, silver and bronze appear only to have been used.

It is substantiated by technical records that the present method of drawing wire was practiced in the Lenne district of Germany

during the fourteenth century, and about the year 1350 a wire drawing mill was erected at Nuremburg by a man named Rudolph.

The first needle manufactory in France was started by an Englishman, named Christopher Greening, at Saint Omer, and the town is this year celebrating the four hundredth anniversary of the establishment of the industry.

About 1600 A.D., it is recorded that at Tintern Abbey on the Wye, pins and needles were manufactured by a Mr. Greening.

In the year 1630, a proclamation was issued by Charles I. to the effect that the home industry had made such advancement that further imports of wire were prohibited.

About the year 1799, Nathanael Greening, who came from Tintern Abbey, commenced the manufacture of wire at Warrington. A few years later the firm of Greening & Rylands was established, and carried on business until the year 1840, when the partnership was dissolved, Mr. Greening taking his sons into business, and establishing the firm of N. Greening & Sons; Mr. Rylands' sons continuing un-

der the firm name of Rylands Bros.

It was with the firm of Greening & Rylands that the late Benjamin Greening, second son of N. Greening of the firm in question, served a seven years' apprenticeship as a wire drawer; then, commencing business for himself, continued until 1858, when he removed to Canada, and became one of the pioneers of the wire industry here.

Under the firm name of B. Greening & Co. he commenced the drawing of wire, wire weaving and rope making, and for many years carried on a successful and steadily increasing business until his death, in 1877, when he was succeeded by his son, S. O. Greening, who built new works and added many new lines to their already extensive business.

In 1889, The B. Greening Wire Co. was incorporated as a joint stock company, with Samuel Owen Greening as president, since which time important additions have been made to their buildings and machinery.

To produce wire, several processes are necessary, which we will briefly explain, that those of our friends who have not had

the opportunity of seeing them may be able to do so at least in imagination.

The iron ore, after being taken from the mine, is converted into cast iron by means of a blast furnace, which, by intense heat, separates the iron from the bulk of impurities with which it is combined, the purified metal being run into rough bars, technically called "pigs," and the impurities drawn off in the form of slag.

These pigs are afterwards treated according to the nature of the metal required. For what is known as puddled iron, a quantity of pig and scrap iron is placed in a reverbatory furnace, and again subjected to intense heat, to further remove carbonaceous and other impurities.

The man in charge of this furnace is called a puddler, and by means of a long iron rod, with a rake or rabble at the end, he works the metal about, which has become half molten or in a pasty condition, until he has gathered a good sized lump, which is called a ball or bloom, weighing about 60 lbs. In its half molten state it is subjected to the crushing blows of a steam

hammer, which further beats out any retained slag.

The next process is the heating of these blooms and passing them between a pair of powerful grooved rolls, which forms the welded iron into a bar.

This bar is cut into short lengths. A number of them are placed together and are known as a "faggot." After being brought to a welding heat in the furnace, they are subjected to the heavy blows of a steam hammer, which drives out any further slag or impurity remaining, and forming the welded mass into a billet. In this form they are taken to the Rod Mill to be again heated, and passing through a train of rolls, are reduced in diameter to about 3/16 of an inch, or 6 wire gauge, which is the size of rod mostly used.

This rod, now ready for the cold drawing process, is first thoroughly cleansed from scale or rust, by soaking in a vat containing sulphuric acid and water. After being immersed long enough to remove the scale, it is thoroughly washed to cleanse it from the acid and loose scale, and plunged into

a vat of lime water to prevent it rusting, until the wire drawer is ready to take it in hand.

Before going to the drawing block the end of the wire is put into a pointing machine, which produces a tapered end, in order to pass far enough through the wire drawers plate or die to enable him to seize with his tongs. By two or three pulls with his tongs he draws enough wire through to fasten the end in a pair of vice jaws attached to the revolving block, and which form a part of the mechanism. He then starts it revolving, each coil of the wire forcing the last further up the block until the coil is finished.

After being drawn or gradually reduced in size a few gauges, the wire becomes so hard that an annealing process is necessary. The coils of hard wire are therefore placed in a large iron cylinder, which is hermetically sealed and the whole mass subjected to fire until it becomes a bright red. After being kept at this heat a suitable length of time, to insure thorough softening, it is allowed to cool slowly, when it again receives

another cleaning and coating, and is further reduced by repeated drawings until brought to the size required.

Iron and steel wire is drawn through chilled iron or steel dies, but some of the precious metals are now drawn through diamonds or rubies, drilled at an immense expenditure of labor. To make one of these dies requires many days of continuous drilling. The delicacy of the work may be appreciated when the size required is represented by the diameter of a hair.

Through an ordinary steel die we have succeeded in our own mill in drawing soft steel wire so fine that it would take 140 wires, laid side by side, to cover one inch. This, we believe, is the finest that has been drawn in Canada.

Some five years ago all the special grades of wire were imported, but we are now turning out, under our own supervision, special wires for the following purposes: high tempered coppered steel spring wire, which is equal to anything that can be produced. High class rope wire, made from the finest Swedish rods. Tinned

mattress wire, for the manufacture of spring beds. Pin wire for making toilet pins, made expressly for the enterprising firm of McGregor, Gourlay & Co., Galt, the pioneers here in this line of business, and many other lines for general and special purposes.

Having given a brief description of the process of manufacture, we will now proceed to enumerate some of the uses to which it is put, none possibly being of greater importance than wire ropes. The nature of the work to which these are subjected calls for the greatest care in the selection and manipulation of the wire of which they are made. There are various grades used, viz.: crucible cast steel, Siemens Martin, (or mild steel), charcoal, and Swedish iron, each suitable to the purpose for which it is intended.

For suspension bridges, mining, quarrying, deep well drilling for gas, and all purposes that require great strength combined with toughness, ropes made from crucible cast steel, treated by a special patented process, are used. The wire, after being

properly tested, first as to its tensile strength, which should be about 180,000 lbs. per square inch, (which means that a bar of the material from which the wire is made, one inch square should lift ninety tons); then as to its toughness, by grasping it in the jaws of a vice and bending it backward and forward at right angles; and lastly, as to its toughness to resist torsion. This test is made by holding one end firmly in a chuck and giving a number of twists to the inch. If it fails in any of these tests, it is condemned as unsuitable for ropes, and has to be laid aside and put to uses where strength is not of such vital importance.

After having passed the necessary inspection it is wound on reels and placed on a rotary frame, where it is twisted into rope.

Ropes requiring great flexibility are made up of a great number of fine wires, to enable them to bend around small sheaves or drums, such as ships blocks, derrick sheaves, etc.

The life of a rope is proportional to the diameter of the pulley around which it is

ent; the greater the circle the less bend n the wire, and as a consequence, a more irect longitudinal and even strain.

The greatest care is required in drawng wire for rope purposes, to keep it exactly even in gauge from end to end, as any difference in size, where so many wires are grouped together, would make the finished rope vary in diameter, so that in dealing with such a hard material, only the best drawplates and the most skillful workmen are able to produce wire suitable for this purpose; indeed it seems wonderful that such extreme precision can be attained, sizes often requiring to be maintained to 1/1000 part of an inch in diameter.

Steel wire ropes are now used very extensively in mining operations, the rapid development of the manufacture of steel during the past few years has so cheapened the production, that it has superseded other cables, having been found more reliable and convenient in every way.

They have also been found very serviceable in the development of gas fields, the great depth of the bore in many of the

wells requiring a cable that combined great strength and toughness to resist abrasion caused by the rocky sides of the hole.

Those of our customers who have had the opportunity of seeing the elegant and stupendous bridges spanning the Niagara River and the river between New York City and Brooklyn, are familiar with beautiful and colossal examples of the uses of wire for structural purposes.

The span of the latter is 1600 feet, at an elevation of 135 feet above high water mark.

These huge suspension cables are composed of 6400 separate wires.

The railway over this structure is another illustration of this class of the many uses to which wire rope may be applied, as the carriages are propelled by a continous cable in constant motion, the conductor having perfect control of the cars by an ingenious grip action, which grasps the rapidly running rope, gently, at first, then gradually firmer, until the full speed of the travelling cable is attained.

Our firm has, during the present year,

upplied a cable to the Hamilton Incline Railway Co., which is another instance. In this case the incline is from the city to the mountain top, and a large quantity of heavy traffic, heretofore carried up by teams, may now be taken by the Incline Railway Co., who have constructed a road capable of taking the heaviest freight as well as passengers, and it gives promise of being a very successful undertaking.

The cars are arranged on two parallel tracks, a car being attached to each end of the cables, for there are two, laid side by side, one of which is of ample strength for the heaviest service expected of it, the other acting as a safety cable in view of any possible accident that may happen to the working cable or machinery. The engine and driving drums are placed on the top of the mountain, and while one car descends the other ascends, carrying its traffic and acting as a counterpoise.

The elevation is about 200 feet; the angle of incline 17½ degrees. The length of the cable is 800 feet, and the diameter 1 and 5/16 inches.

Those who have occasion to visit Hamilton should not fail to avail themselves of this means of reaching the mountain top, as one of the most charming views may be obtained from it.

Immediately below, the visitor sees the handsome residences; an evidence of the energy and success of Hamilton's merchants and manufacturers.

Towards the centre of the city are the stately buildings, which are the head-quarters of many of the largest Insurance, Financial and Commercial Institutions of Canada.

Further north can be seen the tall chimneys of the various stove foundries, rolling mills, forging mills, wire works, machine works, furniture, tobacco and other factories, that entitle Hamilton to be justly called the Birmingham of Canada.

Beyond the city is the beautiful bay with its fleet of vessels for traffic and pleasure, while beyond, stretching out until lost in the distance is seen Lake Ontario.

Ropes made from Siemens-Martin mild steel are used principally for the transmis-

sion of power (through the agency of grooved iron pulleys) when the source of power is some distance from the place it is required, or where a large concern may have a surplus and desire to let off a portion to adjacent manufacturers in separate mills.

Many valuable water privileges that would otherwise be inaccessable are thus utilized, as long distances may be connected at comparatively slight cost.

A typical illustration of this may be seen in the neighborhood of Baden, Ont., where a rope of our manufacture four thousand feet long is driving the flour mills of Messrs. Shirk and Snider.

Stationary cables for quarrying purposes and similar requirements are now much used in rough and rocky districts, where the nature of the ground is unfavorable for the laying of tramways. The cable is anchored between any two points, and a trolley is arranged to run along it, carrying its load and depositing it where required.

In excavations for large sewers in cities, this system is now frequently adopted: the cable is stretched over the line of ex-

cavation, and the earth taken from the trench as it proceeds is deposited within buckets suspended from the cable, which run back to fill up the completed part.

Rapidly running streams have been successfully ferried by the use of wire rope, utilizing the current for the propelling of the vessel by angling it against the stream to cross one way, and by reversing the angle, to return.

The working of the signaling systems of the railways is principally done by means of galvanized wire rope. The standing rigging of our ships is better when fitted with it. It supports the wire by which our electric cars are driven ; it braces the poles that retain the wire in proper position ; on it our wives and daughters hang out their clothes to dry, and in a hundred ways wire ropes are brought into daily use in one form or other.

When the first ocean cable was laid across the English Channel in the year 1850, it was considered a wonderful undertaking, but in a very few years the ever restless spirits of the nineteenth century

entertained the idea that it was possible to lay one across the Atlantic, which, by the aid of that mighty production of Brunel's, (the Great Eastern steamship), was finally successfully accomplished.

To-day the world is girded round by its ocean cables, and distant continents by their aid brought into instant communication.

This country has, within the past few years, successfully completed its railway through to the Pacific, and along its route runs the telegraph wire, bringing the far west into immediate contact with our trade centres in the east.

Wire for fencing purposes is rapidly taking the foremost place, its enduring qualities, the ease with which it can be erected, its great strength and tidy appearance commend it to our progressive farmers. Many thousands of tons are now made annually and used on this continent, and it has been found the most effective agent in checking the ravages of the rabbit in Australia, and many hundred miles of it have been erected for that purpose there. Many

forms into which it is manufactured have great merit, but the woven hexagon fencing commends itself to our judgment as the form likely to supersede all others.

Closely allied to this last, another important industry has within the last few years sprung up, viz., that of making wire nails. Thousands of tons are sold annually, and for many purposes are preferred to the cut nail. Automatic machinery has reduced them to a wonderfully low price. Steel wire chains (made by wonderfully ingenious machinery that takes the wire from the coil and turns out the completed chain at a speed of fifty links a minute) is taking the place for many purposes to which welded chains were formerly applied.

The wire chain is stronger from the fact that there are no defective welds, the links being so constructed that the bends forming them are as strong as a weld, and every link is equal in strength.

Wire weaving ranges through a large field of useful fabrics, graduating from the heavy coal screen and spark arrester of the locomotive, to the fine gauge wire

through which milk is strained and flour sifted.

Woven wire fabrics, embracing as they do such a large proportion of the wire industry, are entitled to more than a mere passing notice; but our space will not permit of more than a brief glance at their merits.

It is not many years ago, when all wire weaving was done with the hand: that is to say, the weft was all shot through by hand. This was a very slow process as compared with the present method, and required unremitting attention on the part of the operator. Although the cotton loom had been constructed on the automatic principle, and worked so successfully, it was thought to be impossible to apply the same principle to the wire loom.

The marked difference between the pliable cotton and the stiff, unyielding wire presented what seemed to be an insuperable difficulty; but the genius of the inventor has triumphed, and now there are looms that are automatic and which work perfectly.

There is considerable difference in the

automatic action necessary to the weaving of the various grades of wire. The fine wire cloth being of a more pliable material than that of a coarser grade, is woven upon looms having a very ingenious copp shuttle, which throws the weft to and fro with the same certainty as does the cotton loom.

It was the hard and coarser steel wire that tried (in the most pronounced sense) the genius of the inventor; but even this difficulty has been overcome.

There is a limit to the application of the automatic principle in the weaving of wire, which is reached when the wire is too coarse and stiff to be wound upon a spool.

The coarser grades of wire therefore remain to be shot through by hand, but the proportion is small in comparison with the whole. Passing over the intermediate grades of wire we at length reach the heaviest and strongest of the series.

The power and strength of this one is enormous, which is shown in the ease with which (by the aid of a pair of powerful cams) it thrusts the wire into proper place, under

a pressure of from 9 to 100 tons (according to grade) at each thread in the web.

The many uses to which woven wire is applied is a pronounced commentary upon that practical wisdom of the age, which seeks to expand every known thing to a greater sphere of usefulness.

Wire is rapidly supplanting wood for lathing purposes. In our largest and best buildings wire cloth for lathing is used, as the grip of the plaster upon it is more thorough and permanent than upon wood. It is also fireproof.

A novel use of wire cloth may be found in its association with glass. The subject of protecting large sky-lights is now one of considerable importance. In such structures as large railroad depots, where the entire arched roof being made of glass is (particularly in winter when the snow falls heavily) a constant menace to life and property. The glass used in their construction is necessarily of considerable thickness, which would, were it to break and fall, with its heavy sharp edges, be capable of inflicting fatal injuries. To remedy this danger, a

firm in Tacona, Pennsylvania, is manufacturing glass combined with wire cloth. The molten glass is poured upon a table and the sheet of wire cloth is laid upon it; a roller is then brought to bear, which presses and imbeds the wire fabric into the body of the glass, which when cool is sent to the annealing oven.

Again we have wire cloth associated with papier-mache, the wire being imbedded in the pulp and rolled under hydraulic pressure until it is as hard as the hardest wood. This is an excellent material for roofing or fibrous ware.

Another novel use is its association with oil and varnish, the mesh of the cloth being absolutely filled and coated. It resembles stained glass, and is used for exhibition buildings, sky-lights, windows and verandahs.

The many uses of wire are apparent to the most casual observer, and if we examine the subject critically we will see that our civilization could not have been what it is without its powerful aid.

The ancients, in their worship of Jupiter

and blind force, little dreamed that at a distant day their deity would be put into harness and led to distribute his power through a thousand and one channels, for the benefit and satisfaction of man, through the medium of wire. Without it the electric motors, telegraphs and telephones could have no place.

And now we will take leave of a subject which commends itself to the consideration of all who are interested in the progress of our age, and if we have succeeded in awakening an interest in it, we shall deem ourselves more than compensated.

NOTE.—We are indebted to the interesting treatise on wire by J. E. Bucknel Smith, C. E., lately issued, for some of our facts and dates.—B. G. W. Co'y.